N E W S
OF THE NATIONAL ACADEMY OF SCIENCES OF THE REPUBLIC OF KAZAKHSTAN
SERIES OF AGRICULTURAL SCIENCES
ISSN 2224-526X
Volume 6, Number 54 (2019), 66 – 71 **https://doi.org/10.32014/2019.2224-526X.81**

UDC 68.05.01; 68.05.29

B. N. Nasiyev[1], I. G. Manolov[2], A. K. Bekkaliyev[1]

[1]Zhangir Khan West Kazakhstan Agricultural and Technical University, Uralsk, Kazakhstan,
[2]Agrarian University Plovdiv, Plovdiv, Republic of Bulgaria.
E-mail: veivit.66@mail.ru, manolov_ig@yahoo.com, bekkaliev_askhat@mail.ru

ASSESSMENT OF GRAZING TECHNOLOGY IMPACT ON SOIL INDICATORS

Abstract. In the territories of semi-desert zone of West Kazakhstan region, pastures occupy about 80% of the area. They are an initial base and material basis of sheep farming, main direction of agriculture. However, the increased grazing load in recent years has changed natural balance and, due to the increased vulnerability of semiarid and arid ecosystems, contributes to their degradation and desertification. All this could not but affect the condition of semi-desert pastures. These processes threaten well-being of livestock production and destabilize habitat of population, and anxious trends require in-depth analysis of the condition of semi-desert pastures, identification of the causes of their degradation and the development of effective management measures taking into account the characteristics of main types of pasture ecosystems. The research aim is agrochemical assessment of grazing land cover depending on grazing technology. As a result of the studies carried out, the negative impact of intensive grazing of farm animals on physical and chemical indicators of pastures of light chestnut soils has been found. Under the influence of excessive grazing, the stock of humus of light chestnut soils decreased by 27.78%, soil compacted by 13.11%, the content of exchange sodium increased as part of exchange bases and unsalted soils became a medium degree of saline. The monitoring established degradation of soil of intensive grazing pastures to degree 2 in terms of humus stock and to degree 3 in terms of density, and structural composition of soil was rated as "satisfactory".

Key words: pastures, soil cover, monitoring, degradation, grazing.

Introduction. Global population growth (the Earth's population will be around 9.2 billion in 2050), global climate change and its adverse effects impact on agriculture, the exhaustion of natural resources which is of great importance for the development of the world agriculture safety of foodstuff and safety and new ethical requirements for the producers all this are future problems, connected with sustainable management of natural resources and investments into production of food and agriculture [1, 2].

Grassland, which is a major part of the global ecosystem occupies 37% of the Earth's terrestrial area, contributes significantly to food security, providing much of energy and proteins ruminant animals need to produce meat and dairy products. It is believed that good management of pastures and improvement of degraded pastures can play a fundamental role in mitigating greenhouse gas emissions, especially in carbon storage and absorption [3, 4].

As everywhere else, the problems of combating the degradation of grazing lands and rational use of grazing ecosystems are also relevant for West Kazakhstan. At present, in the semi-desert zone of West Kazakhstan region, the area of grassless and overgrown with unseemly and poisonous pasture plants is growing. The area of degraded land in places of waterfall and recreation of animals is particularly large. Grazing failure around the villages expanded to 7-9 km. In general, dynamics of these processes currently allow to predict with a high degree of confidence the expansion of pastures degradation to 50% of its area.

Unfavourable condition of pastures is not only due to natural characteristics of the region. This is even more the result of anthropogenic influence. Thus, in recent years, in pursuit of profit, agricultural formations, especially farms without taking into account the conditions of grazing lands, have begun to increase the number of farm animals intensively.

As a result, this led to a significant increase in grazing load, reduced yield and fodder intensity of grazing lands, and increased desertification in huge areas. Particularly dysfunctional is the condition of sand pastures used before, mainly as winter ones, today they are used in other seasons as well [5, 6].

In order to prevent adverse anthropogenic impacts on pastures in modern agricultural agriculture, an adaptive strategy to further increase of food production and agricultural raw materials should be based on the principles of environmental management, which includes a number of activities, of which the most important are: seasonality of pasture release taking into account the state of vegetation cover, its yield; determination of optimal livestock load per unit area [7, 8].

Thus, the main issues of environmentally sustainable grazing are the size of seizure and frequency of pasturing. 65-75 year plant growth can be seized without compromising resumption processes. The exclusion of annual growth at this level forms natural favourable conditions for vegetative and seed renewal of plants, creates prerequisites for annual reproduction of plant mass and eliminates possibility of disruption of environmental ties in the plant community and therefore ensures sustainability of the whole grazing ecosystem [9, 10].

Research methods. The research is carried out in Zhangir Khan WKATU within the framework of the program-targeted financing of the Ministry of Agriculture of Kazakhstan on the topic BR 06249365 "Creation of highly productive grazing lands in the conditions of North and West Kazakhstan and their rational use" and on the topic of PhD thesis "Agrochemical assessment of changes in land cover indicators of pastures of West Kazakhstan region depending on grazing technology" in the territories of "Miras" farm in Saralzhinsky rural district of Bokeyurdinsky area.

Options: Intensive grazing (100% browsing of annual growth of grazing plants - control); Moderate grazing (65-75% browsing of annual growth of grazing plants).

The following indicators were defined in soil samples:

humus (by Turin in CINAO modification (SS 26213-91) [11];

P_2O_5 connections (by I. Machigin in CINAO modification, SS 26205-91) [12];

absorbed bases - by SS 26950-86 [13];

soil density - (method of cutting cylinder by Kachinsky) [14].

The assessment of structural condition of chestnut soils of grazing lands was carried out according to the main indicators of aggregate analysis: by the content of agronomically valuable units in dry screening, estimated according to the criteria proposed by Dolgov and Bakhtin and by structural coefficient [15].

Statistical processing of the study results was carried out by the method of dispersion analysis, using the program Statistica 6.0. [16]. Pasture coordinates: virgin soil plot $N49^0 05.851^1$. $E049^0 08.101^1$, moderate grazing pastures $N49^0$ 08.130^1. $E048^0$ 42.751^1, weak grazing pastures $N49^0$ 09.494^1. $E048^0 42.452^1$, intensive grazing pastures $N49^0 08.614^1$. $E048^0 41.017^1$.

The soil cover of the third zone is light chestnut soils. Almost all light chestnut soils of this zone have clear signs of salt content, which is due to close location to the surface of water-soluble salts. Light chestnut soils are characterized by low natural fertility. Humus content varies between 1.3-1.6% with humus horizon power ($A+B_1$) 35-45 cm. Light chestnut soils are poor in terms of mobile forms of nutrients as well.

Results and discussion. It is known that the increase in browsing intensity has negative impact on soil properties. The soils of degraded pastures are characterized by increased density and slightly reduced structure. Our studies in 2019 showed that the dynamics of soil properties differ depending on browsing intensity of grazing phytocenoses.

The most integrated indicators of soil condition are content of humus , density and structural composition. Therefore, content of humus , density and structural composition of soil were taken by us as indicators. [17-20].

Changes in soil density, structural composition, humus, mobile phosphorus and exchange sodium content have been studied in the pastures with different browsing technologies. The reserves of soil organic matter are determined by 3 main factors: amount of plant matter entering the soil, rate of mineralization of plant residues and grain-size loss of soils. Carbon input into soil with plant residues is due to net primary production [21].

According to the studies, humus content in light chestnut soils of semi-desert zone also depends on browsing technology of grazing phytocenoses.

In the studied pastures of "Miras" farm in semi-desert zone of West Kazakhstan region there was also a close dependence of plant biomass reserves on physical properties of experimental sites soils.

On the territories of "Miras" farm, the lowest content of humus was determined on the pasture with intensive grazing regime. At humus contents of 0.83%, humus stock in 0-30 cm layer is 34.36 t/ha. Compared to the reference area of no grazing, the reduction of humus stock is at 27.78%. Soil of this site according to the adopted standards belongs to Degree 2 of degradation according to humus reserves.

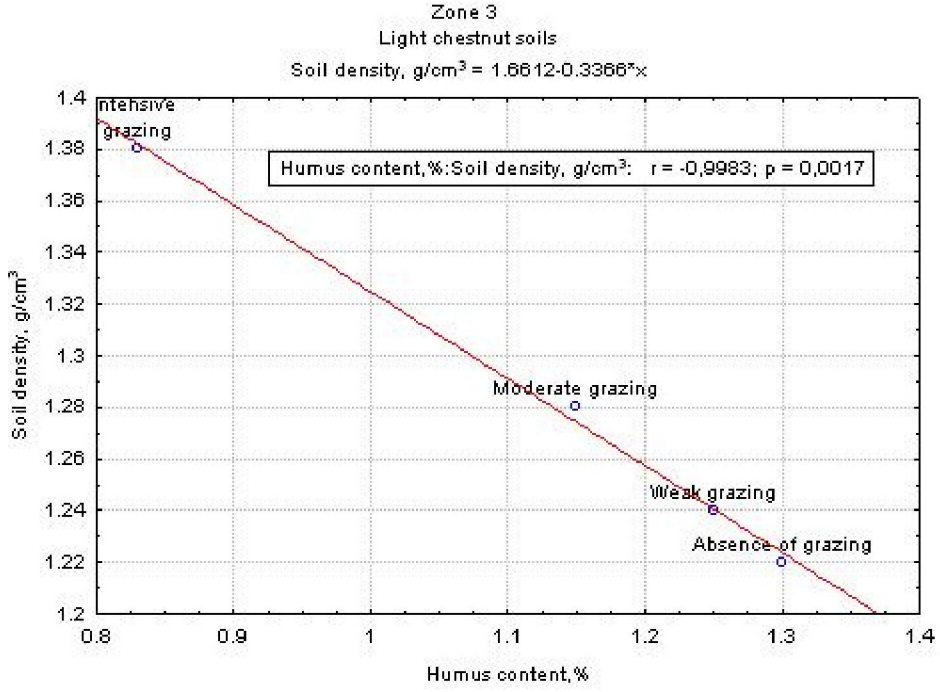
With the use of 65-75% grazing technology by agricultural farm animals, the humus content on the horizon of 0-30 cm light chestnut soils was 1.15%, with humus reserve of 44.16 t/ha. At this site, the decrease of humus reserve in the layer 0-30 cm of light chestnut soils was 7.18%, i.e. the soil according to humus reserves is not degraded.

Changes in humus stocks also occur by linear function on all soil types. Regression analysis has shown that the greatest rate of decline in humus stocks is determined by soil type and has a linear tendency. The most intense decrease of humus in soil with increased intensity of pasture use is observed on light chestnut soils of 3 semi-desert zone.

Soil density also depended on grazing technology. If at the reference site in the soil layer 0-30 cm the density was 1.22 g/cm^3, then at a slight load on the pasture with application of moderate grazing technology the soil density is compacted by 4.91% to 1.28 g/cm^3.

Excessive grazing showed strong soil compaction up to 1.38 g/cm^3, i.e. with intense grazing soil density increased by 13.11% compared to the density of virgin soil or the soil degraded to Degree 3 as a result of overgrazing.

Regression analysis data have determined the dependence of soil density on humus stock. In the layer 0-30 cm of light chestnut soils with increased load when using intensive technology of grazing livestock stock of humus content. The dependence of light chestnut soil density on humus stock was at r2 = 0.9591 (figure).



Dependence of density of light chestnut soils on humus stock when using different grazing technology

The change in the structural composition of land cover of pastures was also dependent on browsing intensity.

From the data of studies it can be seen that in the soil layer 0-30 cm the content of valuable structural aggregates in the soil on areas of pasture with different browsing technologies varies within 53.06-64.91% with structural coefficient 1.24-1.88. At the same time, the condition of moderate grazing soil by the

composition of agronomically valuable structural aggregates (64.91%) is "good," by the gradation of structural factor assessment is also "good" 1.88.

On the contrary, when the load is increased, the state of aggregate composition (53.06%) and structural factor (1.24) is deteriorated to the rating "satisfactory" (table).

Agrochemical and agrophysical indices of light-chestnut soils of semi-desert zone of WKO depending on grazing technology in layer 0-30cm, 2019

Indices	Reference area of no grazing (control)	Grazing technology	
		Moderate grazing (65-75% browsing)	Intensive grazing (100% browsing)
Humus, %	1.30	1.15	0.83
Humus stock, t/ha	47.58	44.16	34.36
Reduction of humus stock, % (degree of degradation)	-	-7.18 (0)	-27.78 (2)
Mobile phosphorus, mg/100g	1.05		
Amount of exchange bases, mg.eq/100g	14.52	15.40	15.65
Exchange sodium, mg.eq/100g	1.30	1.50	1.65
Content of exchange sodium of exchange bases sum, %	8.95	9.74	10.54
Degree of salt content	Weak solonetzic	Weak solonetzic	Moderate solonetzic
Density, g/cm^3	1.22	1.28	1.38
Density increase, % (degree of degradation)	-	+ 4.91 (0)	+13.11 (3)
Content of agronomically valuable structural aggregates, %	75.03	64.91	53.06
Grade rating	Excellent	Good	Satisfactory
Structural factor	3.14	1.88	1.24
Grade rating	Excellent	Good	Satisfactory

Non-systemic grazing through deterioration of agrophysical indices and humus quality has a reducing effect on the content of mobile phosphorus as well. Thus, in the soil layer 0-30 cm at the specified technology on light chestnut soils, the content of mobile phosphorus in comparison with the soil of the reference site decreased by 39.04% or to 0.64 mg/100 g.

Deterioration of physical and chemical properties in turn led to an increase in the content of exchanged sodium in soil, which is an indicator of salinity and increase in the process of soils salinity.

If in the soil layer 0-30 cm of pastures with 65-75% browsing, the content of exchange sodium was 1.50 mg.eq/100g, then with the change of pasture mode in the strand increasing the release of phytocenoses to 100%, the content of exchange sodium increases to 1.65 mg.eq/100g.

At exchange base capacity of 15.65 mg eq/100g, the specific weight of exchange sodium in the cation exchange capacity (CEC) is 10.54%.

As a result of excessive grazing, the soil in terms of the content of exchange sodium changes from low-salt to middle-salt.

Conclusion. Increasing the load on the pastures of semi-desert zone by means of unsystem grazing has a negative impact on physical and chemical indicators of light chestnut soils. The soil of grazing lands in case of excessive grazing is degraded and negative physical and chemical processes are occurring in the soil cover enhancing the process of salinity.

Б. Н. Насиев[1], И. Г. Манолов[2], А. К. Беккалиев[1]

[1]Жәңгір хан атындағы Батыс Қазақстан аграрлық-техникалық университеті, Орал, Қазақстан,
[2]Пловдив аграрлық университеті, Болгария Республикасы

МАЛ ЖАЮ ТЕХНОЛОГИЯЛАРЫНЫҢ ТОПЫРАҚ КӨРСЕТКІШТЕРІНЕ ӘСЕРІН БАҒАЛАУ

Аннотация. БҚО жартылай шөлейт аймағының аумағында жайылымдар барлық ауыл шаруашылығы танаптарының 80% құрайды. Олар ауыл шаруашылығының негізгі бағыты болып саналатын қой шаруашылығының бастапқы негізі және материалдық негізі. Алайда, соңғы жылдары күшейген жайылымдық жүктеме табиғи тепе-теңдікті өзгертті және жартылай құрғақ және шөлейтті экожүйелердің осалдығына байланысты олардың тозуы мен шөлденуіне ықпал етті. Мұның бәрі шөлейт жайылымдардың жай-күйіне әсер етпей қоймады. Бұл процестер мал шаруашылығының әл-ауқатына қауіп төндіреді және халықтың тіршілік ортасын тұрақсыздандырады, алаңдаушылық тудыратын тенденциялар шөлейт жайылымдардың жай-күйін терең талдауды, олардың тозу себептерін анықтауды және жайылым экожүйелерінің негізгі түрлерінің сипаттамаларын ескере отырып, тиімді пайдалану бойынша шұғыл шараларды жасауды қажет етеді.

Зерттеу мақсаты - жайылым технологиясына байланысты жайылымдардың топырақ жамылғысын агрохимиялық бағалау болып табылады. Зерттеу нәтижесінде ауылшаруашылық жануарларын қарқынды жайылым технологиясы бойынша жайғанда ақшыл каштан топырақты жайылымдардың физикалық-химиялық көрсеткіштеріне теріс әсері анықталды. Жайылымның әсерінен ақшыл каштан топырақтардың гумус қоры 27,78% - ға төмендеді, топырақ 13,11%-ға тығыздалды, алмасу негіздеріндегі алмасатын натрий мөлшері жоғарылап, сілті емес топырақтар орташа сортаңды топырақтарға айналды. Мониторинг қарқынды жайылымның жайылымдық топырағының қарашірік қорлары бойынша 2 дәрежеге дейін және тығыздығы бойынша 3 дәрежеге дейін күйзелгенін анықтады, топырақтың құрылымдық құрамы қанағаттанарлық деңгейге ие болды.

Түйін сөздер: жайылымдар, топырақ жамылғысы, мониторинг, күйзелу, мал жаю.

Б. Н. Насиев[1], И. Г. Манолов[2], А. К. Беккалиев[1]

[1]Западно-Казахстанский аграрно-технический университет им. Жангир хана, Уральск, Казахстан,
[2]Пловдивский Аграрный университет, Республика Болгария

ОЦЕНКА ВЛИЯНИЙ ТЕХНОЛОГИИ ВЫПАСА НА ПОКАЗАТЕЛИ ПОЧВЫ

Аннотация. На территорий полупустынной зоны ЗКО пастбища занимают около 80% площади. Они являются исходной базой и материальной основой овцеводства - главного направления сельского хозяйства. Однако усилившаяся за последние годы пастбищная нагрузка изменила природное равновесие и, в связи с повышенной уязвимостью семиаридных и аридных экосистем, способствует их деградации и опустыниванию. Все это не могло не сказаться на состоянии полупустынных пастбищ. Эти процессы вызывают угрозу благополучия животноводства и дестабилизируют среду обитания населения, а тревожные тенденции требуют осуществления глубокого анализа состояния полупустынных пастбищ, выявления причин, обусловливающих их деградацию и разработку эффективных мероприятий по рациональному использованию с учетом особенностей основных типов пастбищных экосистем. Целью исследований является агрохимическая оценка почвенного покрова пастбищ в зависимости от технологии выпаса. В результате проведенных исследований установлено отрицательное влияние интенсивного выпаса сельскохозяйственных животных на физические и химические показатели пастбищ светло-каштановых почв. Под воздействием чрезмерного выпаса запас гумуса светло-каштановых почв снизился на 27,78%, почва уплотнилась на 13,11%, в составе обменных оснований увеличилось содержание обменного натрия и несолонцоватые почвы перешли в разряд средней степени солонцоватости. Мониторингом установлено деградация почвы пастбищ интенсивного выпаса до 2 степени по показатели запаса гумуса и до 3 степени по плотности, по структурному составу почвы имели оценку «удовлетворительное».

Ключевые слова: пастбища, почвенный покров, мониторинг, деградация, выпас

Information about authors:

Nasiyev B. N., Doctor of agricultural sciences, Corresponding member of NAS RK, Professor of Higher School "Technology of crop production" West Kazakhstan agrarian-technical university named after Zhangir khan, Uralsk, Kazakhstan; veivit.66@mail.ru; https://orcid.org/0000-0002-3670-8444

Manolov I. G., Professor, Doctor PhD, Agrarian University Plovdiv, Republic of Bulgaria; manolov_ig@yahoo.com; https://orcid.org/0000-0002-0381-7564

Bekkaliyev A.K. PhD Doctoral Student West Kazakhstan agrarian-technical university named after Zhangir khan, Republic of Kazakhstan, 090000, Uralsk, Zhangir khan Street, 51. E-mail: bekkaliev_askhat@mail.ru

REFERENCES

[1] Scollan N.D., Enser M., Richardson R.I., Wood J.D. Effect of forage legumes on the fatty acid composition of beef. The Proceedings of the Nutrition Society. 2002;61(3A):99A

[2] Rakhimzhanova G.M., Kudaibergenova A. The food security of the Republic of Kazakhstan under the conditions of the food demand change. News of the National Academy of Sciences of the Republic of Kazakhstan. Series of agrarian sciences. Volume 1, Number 49 (2019), PP.55-65. https://doi.org/10.32014/2019.2224-526X.8.ISSN 2224-526X (Print)

[3] Conant R.T., Paustian K., Elliott E.T. Grassland management and conversion into grassland: Effects on soil carbon. Ecological Applications. 2001;11(2):343-355

[4] O'Mara F.P. The role of grasslands in food security and climate change. Annals of Botany. 2012;110(6):1263-1270. DOI:10.1093/aob/mcs209

[5] Zhang K, Zhao K. Afforestation for sand fixation in China. J. of arid environment, 2011, 16/ 1: – P. 3-10.

[6] Ogar N.P. Transformation of Kazakhstan vegetation cover in the conditions of modern nature management. / Institute of Botany and Phytointroduction. - Almaty, 1999. – 131 p.

[7] Shamsutdinov Z.Sh. Long-term grazing agrophytocenoses in the arid zone of Uzbekistan. - Tashkent: FAN UzR, 2012. – 167 p.

[8] Rodin L.E. Productivity of desert communities // Coll.: Resources of biosphere. - L.: Nauka, 1975. - Ed. 1. – 286 p.

[9] Abaturov B.D. Ecological impacts of hoof mammal pasture on semi-desert Ecosystems // Ecological processes in arid ecosystems. XIX readings of memory of V.M. Sukachev. - 2001. – P.57-83.

[10] Bigon M., Harper J., Townsend K. Ecology. Individuals, populations and communities. - M.: Mir, 1989. - Vol.1. – 667 p.

[11] SS 26505-91. Soils. Determination of mobile phosphorus and potassium compounds by Machigin method in CINAO modification. 2002. – 12 p.

[12] SS 26213-84. Soils. Determination of humus by the method of Turin in the modification of CINAO. - M.: Standard, 2002. – 8 p.

[13] SS 26950-86. Soils. Method of determining exchange sodium. - M.: Standard, 1986. – 8 p.

[14] Vasilyev I.P. and others. Workshop on Farming / et al. - M.: Kolos, 2005. – 424 p.

[15] Dolgov S.I., Bakhtin P.U. Agrophysical methods of soil research. M.: Kolos, 1966. – 156 p.

[16] Dospekhov B.A. Methods of Field Experimentation. M: 1985. – P. 55-85.

[17] Khozhanov N.N., Tursunbaev Kh.I., Masatbayev M.K., Khozhanova G.N. Evaluation of empirical links of humus formation with energy factors in the arid zone of Kazakhstan. News of the National Academy of Sciences of the Republic of Kazakhstan. Series of agrarian sciences. Volume 1, Number 49 (2019), PP.40-45. https://doi.org/10.32014/2019.2224-526X.5. ISSN 2224-526X (Print)

[18] Kantureyev M.T. Development of fodder production in Kazakhstan. News of the National Academy of Sciences of the Republic of Kazakhstan. Series of agrarian sciences. Volume 1, Number 49 (2019), PP.46-50. https://doi.org/10.32014/2019.2224-526X.6. ISSN 2224-526X (Print)

[19] Koshen B.M., Shayakhmetova A.S., Toktar M. The process of dehumification of humus in the soil Sarikol district of Kostanay region. News of the National Academy of Sciences of the Republic of Kazakhstan. Series of agrarian sciences. Volume 2, Number 50 (2019), PP.105-109. https://doi.org/10.32014/2019.2224-526X.26.ISSN 2224-526X (Print)

[20] Bekturganova E., Mykhybayev M., Yermekbayev B. The rational land use of agricultural purpose in the land law of the Republic of Kazakhstan. News of the National Academy of Sciences of the Republic of Kazakhstan. Series of agrarian sciences. Volume 3, Number 51 (2019). PP.5-10. https://doi.org/10.32014/2019.2224-526X.27. ISSN 2224-526X (Print)

[21] Titlyanova A.A., Kosnykh N.P., Myronicheva-Tokareva N.P., Romanova I.P. Underground plant organs in herbal ecosystems. - Novosibirsk: Science. Siberian Publishing Company RAS, 1996. – 128 p.